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Socio-economic Dimension of Indoor Radon Gas in West Michigan - A Public Health Discourse and Merit to Use HIT in Shaping Health Behavior

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Socio-economic Dimension of Indoor Radon Gas in West Michigan - A Public Health Discourse and Merit to Use HIT in Shaping Health Behavior

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Abstract: This study focuses on indoor radon levels and socioeconomic data from West Michigan, MI. It was designed to: i) analyze the relationship between indoor radon levels and socioeconomic status of the participating households, and ii) assess the degree of public awareness about the danger of indoor radon gas. The study participants expressed that they knew that radon was negative, and a health risk, but were not equipped with the knowledge to test for or mitigate radon. With nearly half of the participants affected in some way by cancer, radon is a concern and a source for worry among many citizens. Health information technology (HIT) will be an effective tool to shape people's health behavior along with accelerating awareness about radon gas, its health risks, and measures to mitigate unsafe radon level.

INTRODUCTION

Radon is an odorless, tasteless, invisible carcinogenic radioactive gas that is affecting the health of homeowners across the country. Radon is the second leading cause of lung cancer in America and claims about 20,000 lives annually" (www.epa.gov/radon). Despite this, radon is a threat that receives relatively little attention by American society. Despite some efforts by the government and EPA to advertise radon testing and mitigation, many people are unaware of radon and how to test for it. Thousands of homes across the country today potentially have dangerous, carcinogenic levels of radon that is un-mitigated. The threat is not so much the high levels of radon, but the lack of awareness and resources to fix the problem in homes. Radon is a correctable problem, but few households have testing and mitigation systems. This research project aims to obtain data on radon levels of the selected areas and the public's awareness of radon in order to understand what people know, and also what they don't know. This will help us to understand how programs can be improved and created to increase radon awareness. The World Health Organization (WHO), published WHO Handbook on Indoor Radon, "the book focuses on residential radon exposure from a public health point of view and provides detailed recommendations on reducing health risks from radon and sound policy options for preventing and mitigating radon exposure. The material in the "Handbook" reflects the epidemiological evidence that indoor radon exposure is responsible for a substantial number of lung cancers in the general population." (WHO, 2009). A community based sustainable intervention supported by HIT will reduce radon risks and ensure better health.

PREVIOUS STUDIES

Many Americans are aware of the dangers of cigarette smoke inhalation, but they are unaware that radon gas is a naturally occurring cancer-causing element that kills thousands annually. According to the Environmental Protection Agency's website, "Radon is a cancer-causing natural radioactive gas that you can't see, smell or taste… Radon is the leading cause of lung cancer among non-smokers. Radon is the second leading cause of lung cancer in America and claims about 20,000 lives annually" (www.epa.gov/radon). This pollutant affects individuals of all socioeconomic levels. According to one study, radon "is responsible for about 2% of all deaths from cancer in Europe" (Darby et al., 2004). Radon causes thousands of deaths every year which could easily be prevented, but the majority of the public does not understand the risks of radon.

Radon is a gas that we cannot see or smell. "Radon is a noble and inert gas resulting from the decay of naturally occurring uranium-238" (Samet and Eradze, 2000). Although it is a daughter element of uranium, radon does contain all of the same characteristics of the uranium decay chain. However, unlike other components of the uranium chain, radon is able to seep through the soil and contaminate earth and water alike. "It is unlike all other members of the uranium decay chain which…are bound as mineral compounds in the soil, and tend to stay put" (Ginevan, 1988). Since radon is not restricted to being present solely in the soil, it can penetrate air pockets present in the ground level or basement level of buildings.

Because of the propinquity to the source of the radon, these levels are often the ones which contain the highest levels of radon within a household. All of the research that has been done on radon agrees that radon levels are more highly concentrated on the ground floor or below. "In homes, the principal source is soil gas, which penetrates through cracks or sumps in basements or around a concrete slab" (Samet and Eradze, 2000). Radon can also become present in the groundwater because of its concentration in the soil. "Water is a secondary source [of radon gas] which can be significant when water requirements are met from radon-contaminated private water supplies" (Teichman, 1988). It is important to test the amount of radon present. Radon occurs in groundwater naturally as it does in the soil. The existence of radon in either substance does not indicate human interference.

Because radon is a radioactive gas which occurs naturally, humans do not cause its presence within the environment. As was mentioned, radon is a daughter element of uranium, which means that it contains some but not all of the characteristics of uranium. Uranium concentrates in small spaces which accordingly fill with gas faster than larger spaces. Radon concentrates in some areas more than others because of this. "Whenever rock is heated in the presence of fluids, uranium has a tendency to move with the fluid... [until] it stops and becomes concentrated. The end result across the geologically varied U.S. landscape is widely varying concentrations of uranium in [rocks and sediments] that the rock generates" (Kerr, 1988). The variety of radon and amounts present changes from location to location because of this fluidity as well as other factors, such as the incidence of phosphates.

Areas which have phosphate deposits have been found to have a positive correlation between the presence of phosphates and radon gas. This relationship between radon and phosphates has been shown in Israel where radon testing was done at a Jerusalem school. According to the evidence provided by the researchers who worked in this school, phosphate deposits "are a recognized source for radon gas and its daughter products" (Richter et al., 1997). This school had multiple subterranean levels, which increased the amount of radon gas present in the building because of radon's status as an inert gas. The lowest levels of the school also contained the highest levels of radon, as would be expected. The existence of radon inside buildings is not news to scientists. In fact, "Radon was found to be present in indoor air as early as the 1950s, but potential health implications received little notice until several decades later" (Samet and Eradze, 2000).

A male member of the janitorial staff and a female faculty member in the Jerusalem school contracted cancer after spending a decade and a half working in the subterranean levels. These individuals eventually died from breast cancer and myeloma, forcing the school to test radon levels. What the researchers discovered was in line with the understanding of radon's operation as an inert gas. "Radon concentrations were generally higher in rooms in the four levels of the building that were below ground level" (Richter et al., 1997). The radon testing yielded high amounts of radon, 1000 to 15,000 Bq/m^3, resulting in the temporary closure of the school.

Despite the results of these individuals, officials declared that "no valid conclusions can be drawn from this observed relationship between the high basement exposures of these two individuals and their tumors" (Richter et al., 1997). Radon only affects the respiratory system. If both of the individuals had developed lung cancer, then the school would have been held accountable for their deaths through excessive radon exposure. However, it has not been shown that radon causes cancers other than lung cancer because exposure comes from inhalation, directly affecting only the lungs.

Radon is inhaled, meaning that the damage is concentrated in the respiratory system. "Inhaling radon, or more accurately its decay products or 'progeny,' can expose lung tissue to significant doses of ionizing radiation, which may in turn cause lung cancer, a usually fatal disease" (Ginevan, 1988). Because radon obtains its entrance through the respiratory system, individuals who participate in high stress conditions such as jobs performing manual labor will breathe in more radon particles than individuals at rest. This puts miners especially at risk for radon exposure due to their occupation within the earth in a physically active profession.

Many studies have been done to assess the amount of radon miners encounter in their career. It is not only the close proximity to radon-infused soil on all sides of them which erodes the quality of their work environment but also, "the decay products are all metal ions, and as such, they tend to 'stick' to dust particles. A mine is a rather dusty place, so most radon progeny are 'stuck' or attached to dust particles. Small particles are much easier to inhale than large particles" (Ginevan, 1988). This means that not only are they surrounded by radon-containing soil and breathing heavily because of physically exerting themselves, but they are also inhaling more radon because it is easier to inhale in a dusty environment.

The miners are at high risk for radon inhalation without a means to mitigate the problem, but it is possible to mitigate the amount of radon present in a household. "At present the 'active level' recommended by the United States Environmental Protection Agency is 0.02 working levels (a unit of radon progeny exposure rate). Essentially if your house is at or above this level, EPA suggests that you should take action to reduce it" (Ginevan, 1988). If the house tests below the active level, no mitigation is necessary. It is important to note that although radon levels can be reduced drastically, it is not possible to completely remove all traces of radon within a building.

A simple way to reduce the multiplicative effect of radon is to diminish the amount of cigarette smoke in the home. The combination of radon and cigarette smoke on an individual's lungs is much worse than if the individual were being exposed to only one pollutant. A large portion of sample groups used for radon research comes from a community of smokers or former smokers. Research has been done to compare the risks of radon exposure taken from separate studies in different areas of the world, New Jersey, Stockholm, and Shenyang (China). The result of the study allows the possibility that "there was a suggestive positive relationship between radon exposure and lung cancer risk among former smokers" (Lubin et al., 1994).

Several studies have been performed on the interaction between radon and cigarette smoke. One studied concluded that "cigarette smokers have very much higher risks than nonsmokers for a given level of radon progeny exposure" (Ginevan, 1988). By ceasing to smoke cigarettes, the probable risk of contracting lung cancer decreases significantly, even for individuals who are regularly exposed to radon. "If the 40-year-old male continues smoking and exposure to 296 Bq/m^3 (8 pCi/L) of radon indefinitely, his lifetime risk of lung cancer is 23.5%. He can reduce this risk to 19.2% by eliminating radon exposure, but he can reduce it to 4.9% by ceasing to smoke even with continuing exposure to radon" (Ennever, 1990). The increase in lung cancer probability can be assumed to be related to radon exposure and cigarette smoke.

Radon gas and cigarette smoke interact multiplicatively rather than additionally. Accordingly, the resulting effects are increased. "48% of males are smokers with 12 times the lung cancer rate of male nonsmokers, and 36% of females are smokers with 10 times the lung cancer rate of female nonsmokers" (Ennever, 1990). However, Ennever does mention that quitting the habit can drastically reduce the probability of lung cancer regardless of continued exposure to radon gas. It must be noted that a non-smoker will still have less of a chance of contracting lung cancer than a former smoker.

The causes of lung cancer cannot be simplified to only include amount of exposure to radon and cigarette smoke. The majority of studies which have been done to examine the relationship between these two factors have not included many non-smoking individuals. As a result "there remains a paucity of subjects who are not current or former smokers" (Upfal et al., 1995). Because of this, it is an obligation of the researchers performing studies on radon gas to include nonsmokers in their population to balance the results.

Individuals should realize that radon exists atmospherically outside of buildings, mines, and other structures. The level of atmospheric radon present varies, as was discussed in conjunction with phosphate deposits. Measurements have been taken to determine the average amount of atmospheric radon. "The worldwide, population-averaged radon concentration is estimated to be 10 Bq/m^3 (0.3 pCi/l) outdoors and 40 Bq/m^3 (1.1 pCi/l) indoors. In the United States, these averages are estimated to be 15 Bq/m^3 (0.4 pCi/l) outdoors and 54 Bq/m^3 (1.5 pCi/l) indoors" (Steck et al., 1999). The world averages are slightly lower than the averages in the United States, but this variability has to do with landscape rather than culture.

Radon mitigation systems are available to view on the EPA's website. In general, these treatments are rather inexpensive household renovations. According to the EPA, "The cost of a contractor fixing a home generally ranges from $800 to $2,500, depending on the characteristics of the house and choice of radon reduction methods. The average cost of a radon reduction system is about $1,200" (www.epa.gov/radon). One method is to simply provide a ventilation pipe to the outside, while another method is to literally suck the air out of the room via a fan system. It is recommended that houses should be well-insulated. However, "it cannot be generalized that tight (i.e. low infiltration rate) energy efficient households will have high indoor radon levels and loose, less energy-efficient houses will not" (Teichman, 1988).

An additional but more costly alternative to self-improvement is to consult a radon contractor who has experience in modifying buildings to diminish structural faults which allow radon pockets to develop. The EPA is very instructive in how to consult a radon contractor as well as detailing what elements should be present in a contract between the parties involved. These guidelines are helpful for individuals who are unsure how best to mitigate the amount of radon present in their household. Radon contractors are often good to consult because they understand which types of houses need which mitigation system.

For house structures, there are three main types which builders use to determine the mitigation treatment. These structures are: houses with a basement, houses with a crawlspace, and "slab-on-grade" homes. Slab-on-grade refers to houses which rest on a layer of concrete between the floor and the dirt, rather than on top of a basement or crawlspace structure. Additionally, some houses have a basement/crawlspace combination, such as a house with a basement that also has a crawlspace under the front porch. Regardless, the mitigation system is tailored to fit the house's structural context.

The most efficient way to reduce radon's intrusion into the house is to use a ventilation fan to circulate it back outside. "Soil gases do not simply diffuse into a house, the house literally sucks them in…The suction effect is driven by air pumped outside by clothes dryers, fireplaces, or furnaces, as well as by wind blowing around the house and…warmer air rising through the house and out through openings in the top" (Kerr, 1988).

In the previously mentioned case of the Jerusalem school, an elaborate mitigation system was put into place. "A step-by-step program of local venting of underground air pockets in rock was introduced to control and eventually eliminate high levels" (Richter et al., 1997). Unfortunately, this system is a poor choice because slight earthquakes could open new pockets for radon. "Later spikes in the below-ground levels above E-4 suggest that radon gas entered other parts of the building from pockets of gas in high concentrations disturbed somewhere inside the underlying rock…The gases remained in the soil only to penetrate the building along new paths" (Richter et al., 1997).

OBJECTIVES

Radon is problematic in two ways: that it can be present in homes at dangerous levels, and many people do not know about it or understand the health risk. This study aim to understand people's awareness about radon and its health risk. It also aim to explore how radon knowledge is associated with socioeconomic factors of the residents.

METHODS

The author also along with Grand Valley State University students sent out fliers in the surrounding communities of Holland and Grand Rapids, Michigan. In addition several talks have been given at Housing Association offices, Churches, and Heath Fair.

Each student researcher was provided surveys complete with informed consent forms, surveys for the participants, a flier on the radon study itself, and a radon report card. In addition each of them was also provided with three digital radon-testing devices. The device was installed at the basement or belowground closed room. The households ensured that the room is closed 12 hours before the device is set for the test. The test was left to run for forty-eight hours. At the completion of the forty-eight hours, the researcher would again return to the participant's home, record the radon level of the home, inform the participants and obtain signatures on both the survey and the radon report card. The radon report card was given to the household for their record. All surveys were assigned a de-identification number and all information was kept strictly confidential.

Surveys were then reviewed, and data was analyzed using both statistical analysis and qualitative analysis. The data were analyzed using simple statistics. In this particular research, factors such as age of the participant's home, participant's education level and annual household income, and awareness about radon were examined and analyzed to understand any patterns that may exist in relation to radon levels and radon testing. These responses were compared, analyzed and compiled to answer questions about radon awareness in the area and attitudes towards radon and radon testing.

RESULTS

The sample consists of 290 households in the Grand Rapids area, 40% males and 60% females being interviewed. The educational levels are as follows: 14% have no college education, 39% have some college, 27% have obtained a four year college degree and no more education, and 20% have a graduate school degree. The type of employments are: 20% are in business, 28% in education (teacher or student), 8% are in administrative or government positions, 10 are retired, and 35% are in other types of employment. The percentage of interviewees that are White/Caucasian is 91%, 2% are Black/African-American, 6% are Asian, and the other 1% are other nationalities. The percentage of interviewees that are currently married is 59%, with 52% of the houses currently having children in the house. The mean age is 42.57 with a standard deviation of 15.71. The percentage of houses that are owned is 76%. For income, 18% were below \$20,000, 16% had incomes between \$20,000 and \$47,000 and the other 63% had incomes over \$47,000 (out of 279 that responded). The mean number of years living in the house is 11.21 with a standard deviation of 12.05 years.

When asked "Do you know what radon gas is?" 68% answered *yes* and 32% said *no*. In addition, 58% of the households had a family member that has died of cancer and 27% have a family member that smokes. Of the households sampled, 93% have health insurances while 7% do not. Whenever the house had a basement (90%), the radon gas level was recorded in the basement; otherwise, the level was recorded in the living room (10%). The radon level in the air had a mean of 2.437 with a standard deviation of 2.20. Fifteen percent of these reading were over the EPA suggested value of 4.0. The largest value recorded was 21.9 while two houses had the minimum radon gas level of 0.0. A histogram of the radon gas levels is given in Graph 1. The radon gas levels have a skewed right distribution with a number of large outliers.

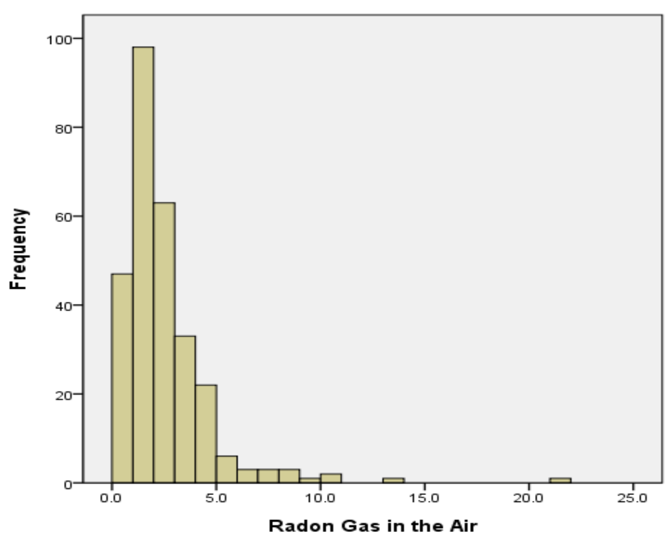

Figure 1. Histogram of Radon Gas Levels

Are there differences in radon gas levels due to demographics or the knowledge about radon gas of the interviewee? Due to the shape of the distribution and the outliers present, parametric tests that assume normality cannot be used in order to run statistical tests to answer this research question. As a result, Spearman's Rho correlation will be used when comparing radon gas levels in the air with quantitative variables, the Mann-Whitney U-test will be used for categorical independent variables with 2 levels and the Kruskal-Wallis test will be used when categorical independent variables have 3 or more levels.

Spearman's Rho was found to measure the strength of the relationship between the radon gas level in the air and each of the three numerical demographic variables (age, years living in the house, and the number of children living in the house). There is a significant positive relationship between each pair of variables except for *radon gas* with *the number of children living in the house* (r = 0.051, p = 0.408); however, the only significant pair that doesn't have an extremely weak relationship is *age* and the *number of years living in the house* (r = 0.717, p < 0.001). Age is moderately related to the number of years the person has been living in the house. The correlation coefficients and p-values are summarized in Table 1. If the test is considered significant at the 0.05 level, an asterisk is given beside the p-value.

Table 1. Spearman's Rho Correlation Coefficients

Variables	Correlation Coefficent	p-value
Radon gas and Age	r = 0.197	0.001*
Radon gas and Years living in house	r = 0.142	0.017*
Radon gas and Number of children	r = 0.051	0.408
Age and Years living in house	r = 0.717	<0.001*
Age and Number of children	r = 0.174	0.004*
Years living in house and Number of children	r = 0.205	0.001*

* denotes significance at the 0.05 level

Mann-Whitney U-tests and Kruskal-Wallis tests were performed separately with radon gas levels in the air as the dependent variable and each of the demographics and knowledge questions being the independent variables. A summary of the results can be found in Table 2. For each independent variable, the table contains a list of the groups used, the test statistic, the degrees of freedom (df), and the p-value. If the test is considered significant at the 0.05 level, an asterisk is given beside the p-value.

The only variables that show a significant difference in the radon gas in the air between the levels of the variable are employment (p = .018), race (p = .004), Children living in house (p = 0.048), house ownership (p = .043), income level (p = .014), and knowledge of radon gas (p = .006). For race, the average amount of radon gas in the air is significantly higher for Caucasians than for minorities. The mean level of radon gas in the air for Caucasians in this study is 2.52 (median = 2; std. dev. = 2.24) while the minorities have a mean level of 1.66 (median = 1.2; std. dev. = 1.55). When considering whether children live in the house, the average amount of radon gas in the air is significantly higher for those with children than for those that don't have children in the house. The mean level of radon gas in the air for houses with children in this study is 2.65 (median = 2; std. dev. = 2.49) while those without children have a mean level of 2.19 (median = 1.7; std. dev. = 1.78). For house ownership, the average amount of radon gas in the air is significantly higher for those that own the house than for those that rent the house. The mean level of radon gas in the air for home owners in this study is 2.61 (median = 2; std. dev. = 2.41) while the renters have a mean level of 1.89 (median = 1.6; std. dev. = 1.16). When considering reported knowledge of radon gas, the average amount of radon gas in the air is significantly higher for those that say they know what it is than for those that don't. The mean level of radon gas in the air for those that know what it is in this study is 2.65 (median = 2.1; std. dev. = 2.42) while those that don't know have a mean level of 1.98 (median = 1.6; std. dev. = 1.55). When considering employment, there are five different categories being considered. Using a Bonferroni adjustment on the significance level in order to get an overall significance of .05, the average amount of radon gas in the air is significantly higher for those in "other" types of employment (other than business, education, administrative, or retired) than for those in business. The mean level of radon gas in the air for those in the "other" category in this study is 2.86 (median = 2.25; std. dev. = 2.78) while those in business have a mean level of 1.92 (median = 1.6; std. dev. = 1.50). When considering income, there are three different categories being considered. Using a Bonferroni adjustment on the significance level in order to get an overall significance of .05, the average amount of radon gas in the air is significantly lower for those with an income under $20,000 than for the other two income categories (between $20,000 and $47,000 and over $47,000). The mean level of radon gas in the air for those with an income below $20,000 in this study is 1.83 (median = 1.4; std. dev. = 1.49) while those with incomes between $20,000 and $47,000 have a mean level of 2.55 (median = 2.1; std. dev. = 1.57) and those with incomes over $47,000 have a mean level of 2.56 (median = 2; std. dev. = 2.46).

Table 2. Comparing radon gas in the air for levels of the independent variable

Independent Variable	Levels of the Variable	Test Statistic	df	p-value
Gender	Male Female	-0.27	N/A	0.791
Education	No College Some College 4 year Degree Grad Degree	2.24	3	0.525
Employment	Business Education Administrative Retired Other	11.89	4	0.018*
Race	Caucasian Not Caucasian	-2.86	N/A	0.004*
Married	Married Not Married	-0.70	N/A	0.484
Children living in house	Yes No	-1.98	N/A	0.048*
House Ownership	Own Rent	-2.03	N/A	0.043*
Income	< $20,000 $20,000 - $47,000 >$47,000	8.53	2	0.014*
Knowledge of radon gas	Yes No	-2.73	N/A	0.006*
Family Member died of cancer	Yes No	-1.33	N/A	0.184
Family member that smokes	Yes No	-0.31	N/A	0.759
Have Health Insurance	Yes No	-0.74	N/A	0.458
Radon tested before	Yes No	-1.08	N/A	0.281

* denotes significance at the 0.05 level

ETHNOGRAPHIC FINDINGS

It is important to share the social meaning of the numeric data. As it appears in table 2 that households with children have higher radon level and families that own a house have higher radon level. While the same table showing people's knowledge about radon is pretty good.

It was an opportunity explains the numerical facts through ethnographic explanations. While people are saying they are knowledgeable about radon; it basically means they heard that radon is a gas and while you buy or sell a house all should measure radon level. Almost all of them do not know what is standard level or safe of radon gas. They are not sure why they should test their radon levels, what is the health risk associated to higher radon level is not even known to them.

This is common to all the communities we have covered, for example, in wealthy "Ada Township", people earn on an average 83,000 in compare to 47,000 in the township's Kent County. People are very aware about carbon-monoxide gas as it can be noticed by smell but radon gas does not have any odor or we cannot see it.
Many households with children make bedroom(s) for the children in the basement where the radon accumulate the most amounts. When they hear that it is not sage to live in a place where the radon in indoor air 4 per litter of air, if anyone inhale such gas with radon more than 4 are susceptible to cancer. People were surprised when they came to know that radon gas causes lung cancer and about 25,000 people die each year in US due to that. It is the 2nd cause of lung cancer.

People usually hear about this gas in January – the government declared radon month. People hear about the radon gas from Radio, TV, and newspaper. It seems the news on radon could not convey the unexpected facts. Society is not having enough knowledge to be aware about the danger of the gas.

SUGGESTED STRATEGIES

Based on the data analyzed from the survey and ethnographic record from the ten participants, it can be suggested that the government or local government should introduce new policies concerning radon testing and mitigation in homes. Despite previous efforts of the government to address the radon problems, i.e., the EPA's campaign, few things have been implemented in communities to enforce regular testing. Before someone purchases a home, or even places it on the market to sell, the home should be tested for radon as a mandatory part of the home buying and selling process. On the same note, all new construction should be tested for radon, and a mitigation system should be installed before the home is placed on the market for sale. However, as seen in the data, testing and mitigation is useless without proper education of the public. Programs should be put in place to educate the public about the risks and realities of radon. This could include sending out education fliers or pamphlets from the health department, placing ads on local television and radio stations, providing an informational website, and starting town meetings and programs. These meetings could occur during regular town meetings and be publicized on local access channels, and could include a radon expert from the government, health department, or a local university that would talk on the dangers, realities, and facts of radon. The program could show what radon testing and mitigation systems look like, and explain how they work. With education, radon and its risks could become a part of the culture as prominently as the danger of smoking cigarettes.

HEALTH INFORMATION TECHNOLOGY (HIT) – TOOL TO SHAPE HEALTH BEHAVIOR

There is a missing link between the wonderful educational resources that we have on radon and people's perception about it. Most of the people do not know the safe radon level which is below 4 pCi/L as recommended by the US EPA. People consider radon testing in buying or selling houses, it is done simply to see if they can reduce the home price when the radon level is high. People see radon level is an item of negotiating home price rather than the risk of disease like cancer. It will be highly effective to use health information technology in educating people on health concerns like risk of indoor radon and how to reduce unsafe radon level. Institutions like the WHO, US EPA, NGOs have prepared very useful educational tools like book and website with easy to use text. All these excellent resources need to be reached to the target population. Mobile phones, internet, social media can be used to convey important lessons on radon, its health risk, and how to mitigate it in a cheaper price.

CONCLUSION

Throughout the radon research project, it has become clear that radon can be anywhere and awareness about radon is very superficial. More than half, 62%, of participants knew of radon, and 86% of those who were aware of radon knew of the risks. The participants expressed that they knew that radon was negative, and a health risk, but were not equipped with the knowledge to test for or mitigate radon. With nearly half of the participants affected in some way by cancer, radon is a concern and a source for worry among many citizens. It is clear that local resources are not easily accessible or not available to the community, and radon is not being mitigated as effectively as it should be. High levels of indoor radon do exist, and intervention programs need to be implemented to address this risk. Members of the community are not receiving the education or information about basic health-related topics, and this poses a threat to community residents. Communities should have a full understanding and command of the various aspects of their lives, including their indoor air quality. With proper education, radon can be introduced into American culture as not a mysterious killer, but a routine test for all homes. HIT is definitely an efficient and effective tool in taking care of radon risk on our health.

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